EXPERIMENTAL CONSTRUCTION 98-3

POTENTIAL BENEFITS OF ADDING EMULSION TO RECLAIMED BASE MATERIAL

Interim Report - Second Year

INTRODUCTION

Rehabilitation of deteriorated asphalt pavements has become one of the primary tools utilized by the Construction Division of the Maine Department of Transportation (MDOT). One method used to achieve this task is the use of pavement reclaiming.

In an effort to improve the benefits of reclaiming, a study was undertaken to compare the properties of reclaimed material treated with emulsified asphalt, to material without this emulsion treatment.

PROJECT LOCATION/DESCRIPTION

Two projects were originally selected for this study, STP-6666(00)X in Winslow-Benton, and STP-7697(00)X in Passadumkeag-Lincoln. Problems encountered during the construction process necessitated the exclusion of the Winslow-Benton project. The Passadumkeag-Lincoln project is located on Route #2 and begins 0.42 km northerly of Beaver Brook Bridge #2059 in Passadumkeag and extends 20.4 km to the Access Road in Lincoln (see attached location map).

The original experimental feature for this project included three sections; the experimental section from station 1+900 to station 2+900 and two control sections from station 1+400 to 1+900 and station 2+900 to 3+400 respectively. The experimental section consisted of reclamation of the existing pavement and introduction of an MS-2 emulsified asphalt at a rate of 6.0 liters/square meter. Treatment of the two control sections included reclamation of the existing pavement with no emulsified asphalt added.

Each section was overlaid with 40 mm of Superpave 19.0 and 35 mm of Superpave 12.5.

CONSTRUCTION PROCEDURE

Reclaiming was performed using a CMI reclaimer. The MS-2 emulsified asphalt was incorporated into the reclaimed material by pumping the liquid directly from a tank truck to the reclaimer's spraybar.

A first pass was completed with the reclaimer to pulverize the existing pavement. A second pass was then made to add and mix the emulsion with the reclaimed base material. This material was then compacted using a Caterpillar vibratory roller. Density measurements were taken using a Troxler 3430 nuclear moisture-density gauge.

During the placement of the emulsified asphalt between stations 1+900 and 2+400, the contractor experienced problems with the emulsion metering system which caused an excess of emulsified asphalt to be added to the reclaimed base material. The amount added to the first 2.4 meter pass was sufficient to cover the entire 7.3 meter roadway width. To correct this, the contractor used a grader to blend the material containing excess emulsion into the remaining roadway width. MDOT personnel monitoring the operation were comfortable that this provided adequate distribution of the emulsion throughout the width of the pavement base.

Construction of the section from station 2+400 to 2+900 went as planned. The spraybar delivered the proper amount of emulsion during each of the three passes to provide a uniform application.

It was noted during construction, that there appeared to be several different existing roadway structure types within the experimental and control areas. Different pavement thicknesses, gravel depths, and subbase materials, including penetration macadam, were encountered. It is believed that this may be the result of a previous research effort by MDOT.

FIELD INSPECTION SUMMARY

Falling Weight Deflectometer (FWD) Data Collection/Analysis

As discussed in the First Year Interim Report, review of the original construction plans (dated late 1940's), identified two significantly different construction procedures in the experimental area. The first section, which began at approximately station 0+100 and ended at station 2+300 was treated with three inches of macadam, five inches of crushed stone base and 18 inches of gravel. The second section from station 2+300 to the end of the project was treated with two inches of asphalt treated gravel and 24 inches of gravel. Considering these differences and the variation that also occurred during the 1997 construction of the emulsion portion of this project, two subsections were created within the emulsion treated area. Data presented in this report compare Control section #1 (1+400 - 1+900) with Experimental section #1 (1+900 - 2+400), and Experimental section #2 (2+400 - 2+900) with Control section #2 (2+900 - 3+400).

On September 9, 1999, FWD data was collected on each of the four sections at 50 meter intervals in each lane. A series of five drops, each at 9000 pounds was completed at each test point. Sensor #1 deflections (located at the impact point of the force load) were compared to sensor #1 deflections collected during the 1998 field inspection. Deflections collected on the original roadway in June of 1997 were also included in this comparison. The 1999 deflections indicated an increase in strength when compared to the 1998 results. These increases were fairly uniform throughout each of the four sections with the exception of Control section #2. This section showed the greatest percentage of decrease in deflection which represents an increase in strength. It is not certain what may have caused this increase, but the extremely dry conditions throughout the summer of 1999 are believed to have played a part in these results. Deflections for each of the three years were corrected for temperature using the Temperature Adjustment Factor from the "AASHTO Guide for Design of Pavement Structures 1993". The results of this comparison are presented in Table I (attached).

In an effort to identify possible causes for the increased strength values, and evaluate FWD readings more extensively, data collected at corresponding test locations in 1998 and 1999 were analyzed using the AASHTO pavement design software "DARWin 3.01". Pavement Modulus, Subgrade Resilient Modulus and Effective Structural Numbers were developed to compare the percentage of change for each. The Pavement Modulus value represents the pavement and gravel layer, while the Subgrade Resilient Modulus value is a measure of subgrade layer strength and elasticity. The Effective Structural Number is a value of the "overall" roadway strength. Single values for each of these three criteria were also developed for each section using all of the locations within each of the four areas.

Comparisons once again showed relative uniformity within the four sections with the exception of the subgrade resilient modulus value in control section #2. This value increased by 18.47 percent when compared to 1998. This appears to reaffirm the theory that changes in the subgrade due to the dry conditions are also impacting the deflections at the surface. Results of this analysis are attached.

Additional FWD data was collected in each section to allow evaluation with the "Section Uniformity" process. A 200 meter subsection was established in each of the four sections and testing was performed at an even interval (every 5 meters) to create 40 data sets.

"Section Uniformity" was developed by William Phang of ITX Stanley using Long Term Pavement Performance (LTPP) data collected on sections of roadway located throughout North America. The results of Mr. Phangs initial efforts are presented in the report titled "LTPP Data Insight - Section Uniformity Using FWD". In general, the Section Uniformity theory states "the more uniform a given section of roadway is, relative to its pavement deflection, the longer life it will have".

The COV is the standard deviation divided by the average, reported as a percent.

Figure I was taken from Phangs research and depicts ranges of classification using COV.

Figure II presents the results of the COV analysis.

Figure I

<u>Coefficient of Variation (COV)</u> <u>Classification</u>

< 10 % Excellent

> 10 % and < 15 % Good

> 15 % and < 20 % Fair

> 20 % and < 25 % Fair - Poor

> 25 % Poor

Figure II

# of Standard Avg. Sensor #1

Section Station Samples Deviation Deflection (Mils) COV %

Control #1 1+400 - 1+900 40 0.73 8.41 8.66

Exp. #1 1+900 - 2+400 40 0.82 8.64 9.44

Exp. #2 2+400 - 2+900 40 1.47 12.20 12.05

Control #2 2+900 - 3+400 40 1.19 14.16 8.39

Figure III summarizes Subgrade Resilient Modulus, Pavement Modulus, Structural Number, Sensor #1 Deflections and COV values for each section.

Figure III

Subgrade Pavement Structural Sensor #1 Avg.

Section Modulus (psi) Modulus (psi) Number Defl. (Mils) COV %

Control #1 10598 115362 7.23 8.41 8.66

Exp. #1 10913 116188 7.25 8.64 9.44

Exp. #2 7489 81619 6.44 12.20 12.05

Control #2 6631 78122 6.35 14.16 8.39

Visual Inspection

On September 9, 1999, a visual inspection was also completed. Some signs of cracking and raveling at the center pavement joint were present. Only 11 meters of load associated cracking was identified (Control #2), and ½ transverse crack was present in experimental section #2. Figure IV summarizes the cracking and raveling identified during this evaluation.

Figure IV

Center Joint

Cracking/Raveling Transverse Load Assoc.

Section Station Linear Meters # of Cracks Linear Meters

Control #1 1+400 - 1+900 207 - -

Exp. #1 1+900 - 2+400 126 - -

Exp. #2 2+400 - 2+900 32 ½ -

Control #2 2+900 - 3+400 192 - 11

Summary and Future Inspections

Overall, each of the four sections remain in very good condition. Data summarized in Figure III indicate no significant differences in the experimental and control sections. To date, it appears the emulsion added to the experimental sections of this project has not enhanced the structural strength of those sections.

FWD testing will be performed in April 2000 to determine if the emulsion sections have different performance characteristics during spring thaw. FWD data collection will also be performed during the summer of 2000 as scheduled. Results of each of these evaluations will be presented in the form of the third year interim report.

Prepared by: Reviewed by:

Stephen Colson Dale Peabody

Other Available Documents:

Construction Report - Jan. 1998

First Year Interim Report - March, 1999